Develop a visual stimulus with ambulatory device for Parkinson's patients to improve the stride length.

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Background and purpose

Parkinson's disease (PD) is persistent and progressive disease of nervous system. The pathology of basal ganglia which affects the consistency of Dopamine results in movement disorders. PD has been found to affect an elderly population, especially over 75 years of age. It isn't caused by sexes and genes. According to examination of epidemiology, there are about 25'000 people in Taiwan. In the other country, the United States, affecting approximately 1% of people over 65 years, and increasing the rate by older age. In the clinical observation, signs of Parkinson's disease are conventional. The common symptoms of akinesia are listing below and having a description：rigidity、bradykinesia、postural reflexes、tremor, and so on. Gait problems are also common symptoms that might cause fall, slip, and flip. PD patients often met accidents. In order to improve the gait performance and prevent from generating a shuffling gait, PD would usually receive external cues or physical therapy. Some researchers verified that visual, auditory, and tactile cues could help PD patients, especially visual tool in stride length. Furthermore, dual-motor tasks would aggravate gait. So only using visual cue is the best method enhance the stride length. But no references indicated that visual cue plays which the role is, direction or step line. Ambulatory devices are common tools for PD patients who have balance problems and postural impairment. Whether standard or wheeled walkers with laser light is used by patients, it is proved that could not improve the gait including stride length, cadence, and velocity, freezing symptom which also often leads to fall would be aggravated by standard walker. Our purpose is to design a walker with laser light to assist PD patients to improve their stride length.

Methods and materials

Walker design is referred by posterior walkers which are usually manufactured for children. And the parameters were on the basic of database of Taiwan labors' body measurements. The walkers was done, its control mode is push inside the walker. Another device is visual cue. In order to play two roles and control the position of laser light precisely, we selected micro step motor whose highest resolution is 20'000 and Programmer System on chip (PSoC) designer produced by Cypress company. We lay rotary Encoder on rear wheel which only could go forward in order to prevent users who had balance problems or were unfamiliar to this ambulation device from accidents. When the chip received the signals from the rotary encoder, motor would be actuated to control the laser projective positions which were calculated by program writing with Matlab 7.0. Through embedded system worked, the motor control could be precise and flexible followed by subjects. We recruited three participants with PD from National Taiwan University Hospital. And we used Motion capture to record the gait in several conditions. Including walking independently or usual assistive device, posterior walker we designed only, posterior walker with direction light which is 60cm apart from the walker, posterior walker with two or three kinds of step line which was referred from above-mentioned experiments, and standard walker only.

Results

Case individual description is suited to this research. Results exhibit two subjects could step on the appointed transverse line on the floor and their stride length would be improved. The role of the laser light from the two participants' performance is step line function. But in the other case, we found out that patients who with severe freezing and shuffling gait couldn't achieve to step on the transverse line would get smooth gait in each laser light condition. People who ever used the standard walker were familiar with the device, so they could have a better performance than walking independently. In our observation, some people with PD who didn't have a sense of security in walking independently would reduce their stride length.

Discussion

Although not everybody could accomplish the request completely, they got better performance when they saw the laser light. Sensory-cue actually increased patients' performance, and posterior walker which is matched with visual cue wouldn't cause light shelter. In the observation, patients with PD who received the external assistant had different performance according to their status. Maybe it should assess patients' abilities and symptoms, then providing laser functions. We could sure that posterior walkers helped the three patients stabilize their status, and posterior walkers with laser light is feasible. Next step maybe add turning function and moving backward to train or assist their daily activity.

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